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6 March 2009

Stan Perry, Esquire  
Haynes Boone LLP  
One Houston Center  
1221 McKinney Street, Suite 2100  
Houston, TX 77010-2007

**RECEIVED**  
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HAYNES & BOONE LLP.

**Re:    *Rebuttal Report*  
      *Ben Brown v Shell Oil*  
      *EPI Project # 29013***

Dear Mr. Perry:

This rebuttal report summarizes my opinions regarding the methodology, assumptions, and resources used by the plaintiff's experts, Dr. Mark Nicas and Dr. Melvyn Kopstein in their assessment of the plaintiff, Ben Brown's, potential benzene exposures. Mr. Brown was reportedly diagnosed with multiple myeloma on 3 February 2007<sup>1</sup>.

I am qualified to provide opinions in this case due to my experience of more than 32 years as an industrial hygienist. Currently, I am President of Environmental Profiles, Inc. (EPI) in Baltimore, Maryland. Formerly, I was with the National Institute for Occupational Safety and Health and led a group of industrial hygienists conducting research for the National Occupational Exposure Survey. As an industrial hygienist for the United States Coast Guard, I conducted thousands of exposure assessments of a wide range of products, including numerous benzene-containing materials. My responsibilities also included the management of the occupational medical monitoring program for the 5<sup>th</sup> Coast Guard District. I was President of the Chesapeake Section of the American Industrial Hygiene Association (AIHA) and was a member of the national AIHA Product Health and Safety Committee and the Emergency Response Planning Committee. I have also authored the *Health and Safety Audits Manual*, published by Government Institutes, and the *AIHA Hazard Communication Guide*, published by the AIHA. The American Board of Industrial Hygiene certifies me as an industrial hygienist and the Board of Certified Safety Professionals certifies me as a safety professional. My curriculum vitae is attached as Attachment I and my four-year history of testimony is attached as Attachment II. Environmental Profiles, Inc. charges \$285 per hour plus expense for my time in preparation and testimony in this matter.

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<sup>1</sup> Complaint

**Exhibit B**

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### **Plaintiff's Methodology, Assumptions and Resources**

Dr. Mark Nicas's estimation of Mr. Brown's 8-hour Time-Weighted Average (TWA) daily exposure to benzene from paraffin cutting at well heads is neither relevant nor reliable for the following reasons:

- He used inappropriate air monitoring data to be representative of Mr. Brown's airborne exposure,
- He used a mathematical input variables model for the dermal exposure calculation, that has not been validated,
- He utilized a skin absorption value in the model that was based on pure benzene and not a hydrocarbon mixture,
- He inappropriately added this dermal equivalent value to his inhalation value and compared this combined value to the airborne Occupational Safety and Health (OSHA) Permissible Exposure Limit (PEL) for benzene and the airborne American Conference for Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) for benzene.

Dr. Nicas's estimation of Mr. Brown's potential short-term exposure to benzene from the cleaning up of oil spills is neither relevant nor reliable for the following reasons:

- He provided no basis to assume that 1% of the benzene would evaporate rapidly from the crude oil spill.
- He described a fixed environment (air space around Mr. Brown) that does not represent Mr. Brown's outdoor work environment and
- He did not account for the substantial dilution ventilation or air flow through the breathing zone or the air space around Mr. Brown on an off-shore platform.

Dr. Kopstein's opinion that Mr. Brown was excessively exposed to benzene was based on two key documents. These documents cite tasks and environments that are not representative of Mr. Brown's work environment or work tasks, and therefore do not support his opinion.

Dr. Kopstein's reliance on odor threshold for determining Mr. Brown's airborne exposure to benzene is not an accepted industrial hygiene practice nor is it a reliable method to predict the air concentration with any degree of certainty, especially in a mixed hydrocarbon.

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## Background

The industrial hygiene data provided to date was not specific to Mr. Brown's job tasks but is more generic in nature. Mr. Brown provided testimony regarding his job duties and tasks while he was a maintenance trainee, maintenance man, and lease operator. However, Mr. Brown did not provide information regarding the products he used to accomplish some of these required tasks. He referred to the use of solvents to clean up platforms, tools, remove paraffin from wells, and even clean his hands and arms. Mr. Brown never identified the types of solvents used to accomplish these tasks. He did identify one solvent as naphtha, that was stored on the platforms in drums. When Mr. Brown was asked about the solvent he used to clean himself with after cleaning a test vessel, he responded, "I only knew of one kind out there. A solvent is a solvent, you know."<sup>2</sup> Information regarding the products used by Mr. Brown is critical in order to accurately assess occupational exposures. This rebuttal report describes appropriate exposure methodologies and details as to how Drs. Nicas and Kopstein's failure to follow this methodology renders their opinions regarding Mr. Brown's alleged benzene exposure neither relevant nor scientifically reliable.

## Exposure Assessment Methodology

Comprehensive exposure assessment is the systematic review of the processes, practices, materials, and division of labor present in a workplace that is used to define and judge exposures (Mulhausen and Damiano 1997). In other words, an exposure assessment describes the magnitude (concentration), frequency, and duration of a person's exposure and involves the integration of the work process and environment, the work tasks, the personal protective equipment, and the properties of the chemical or physical agents. The following basic tools are used to conduct an exposure assessment:

1. a characterization of the environment in which the exposure occurred (including room size and ventilation rate);
2. a characterization of the job and tasks conducted in that environment (including frequency and duration of exposures);
3. a characterization of the products (including volatility);
4. a review and analysis of historical exposure data collected during tasks involving the appropriate handling of the product;
5. evaluation of exposure data to determine whether accepted air sampling and analytical techniques and/or modeling were used to assess the magnitude of exposures; and,

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<sup>2</sup> Deposition of Ben Brown taken 7 January 2009, page 77

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6. a characterization of the relevant safety and health regulations and the associated exposure limits.

The industrial hygienist's training, skills, and experience qualifies him or her to direct efforts for collecting critical information for basic characterization, designating similar exposure groups, and identifying important occupational exposures (Ignacio and Bullock 2006).

Because it is difficult to measure exposures to every worker, the strategy employed by industrial hygienists is to assemble workers believed to have similar exposures into a similar exposure group (SEG). A SEG is a group of workers having the same general exposure characteristics because of similarities and frequency of the tasks they perform, the materials, and processes with which they work, and the similarity of the way they perform the tasks (Ignacio and Bullock 2006).

Air monitoring for determination of employee exposure is presently the standard method for evaluating exposures for purposes of comparison with occupational health standards. However, no sampling data for Mr. Brown is available. Therefore, in order to assess Mr. Brown's benzene exposure, the industrial hygienist may use exposure data available in the published literature of workers having similar exposures to Mr. Brown or exposure assessment models can be used to retrospectively evaluate his potential exposures.

### **Retrospective Exposure Assessment**

#### ***Retrospective (Historic) Exposure Assessment is Part of Industrial Hygiene Practice***

- Retrospective exposure assessment and individual dose reconstruction are tools that have been used by industrial hygienists, epidemiologists, and other health professionals for many years, and are a part of the traditional exposure assessment process.<sup>3,4,5,6</sup>
- Exposure assessments and retrospective exposure assessments are methods upon which industrial hygienists and other trained experts routinely rely. Industrial hygienists contribute to the development of the information necessary to reconstruct historical exposure dose.

<sup>3</sup> Esmen N.A. "Retrospective Industrial Hygiene Surveys" Am. Ind. Hyg. Assoc. J. 40 (1979): 58-65.

<sup>4</sup> Checkaway et al., Industrial Hygiene Involvement in Occupational Epidemiology, Am. Ind. Hyg. Assoc. J. 48 (1987) 515-523.

<sup>5</sup> Mona Baumgarten, J. Siemiatycki, G. Gibbs, Validity of Work Histories Obtained by Interview for Epidemiologic Purposes, Am. J. Epidemiol. 118 (4) 1983.

<sup>6</sup> Denis Hemon, et al. Retrospective Evaluation of Occupational Exposures in Cancer Epidemiology: A European Concerted Action of Research, Appl. Occup. Environ. Hyg. 6 (6) 1991.

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Retrospective exposure assessments are useful tools to calculate historic exposures only when the methods employed are standardized and validated, and factors used in the estimates are truly representative of the historic products, work practices, and environmental conditions.

Exposure assessments can consider multiple routes of exposure: inhalation, dermal, and ingestion. OSHA and NIOSH have published standard methods to measure many different solvents in the air. Sampling and analytical error rates have been measured and are reported for each of these methods.<sup>7</sup> Standard methods for air sampling and analysis are published, readily available, and widely used.<sup>8</sup> By contrast to air monitoring, the assessment of dermal exposures and dermal dose are not relevant, reliable, or consistent with standard industrial hygiene practice. According to OSHA:

“In comparison to air sampling and even biological monitoring, dermal dosimetry is not a simple or routine procedure. Thus far, its use is limited to research and to specially designed studies. An individual applying dermal dosimeters should be thoroughly trained regarding the placement and retrieval of the dosimeters and recording of observations and other information about the activity. In addition to objective parameters, observed work practices can also have statistically significant important influences on dermal exposure, as observed by Popendorf.”<sup>9</sup>

### Dermal Exposure Assessment

***Dermal Exposure Assessment is not a standard Industrial Hygiene method for quantifying exposures for comparison with Occupational Exposure Limits.***

- The tools and the input variables to quantify dermal exposure to organic solvents such as benzene have not been standardized nor validated and remain in development.<sup>10,11</sup> Quantitative dermal exposure assessment is not standard practice for industrial hygienists for comparison with occupational health standards and guidelines.
- The dermal estimate relied upon by the plaintiff's exposure assessment expert is based on the penetration rate for a solvent through a person's skin (flux). Flux

<sup>7</sup> NIOSH Manual of Analytic Methods is available at <http://www.cdc.gov/niosh/nmam/> and includes validated sampling and analytical methods. OSHA validated sampling and analytical methods are available at <http://www.osha.gov/dts/slc/methods/index.html>. Information regarding limit of detection, range, and precision; i.e. sampling and analytical error is provided for validated NIOSH and OSHA methods.

<sup>8</sup> *ibid.*

<sup>9</sup> OSHA. “Dermal Dosimetry” <http://www.osha.gov/SLTC/dermalexposure/dosimetry.html>

<sup>10</sup> Fiserova-Bergerova V. “Letter to the Editor: RE: Response to Bunge's Letter to the Editor.” *American Journal of Industrial Medicine* 34 (1998): 91.

<sup>11</sup> Jakasa I and Kezie S. “Evaluation of in-vivo animal and in-vitro models for prediction of dermal absorption in man.” *Human & Experimental Toxicology* 27 (2008): 281-288.

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values for benzene (100% or neat) have no known error rate. The issue is further complicated, because the flux value for a solvent in a product mixture is highly dependent on what other materials are in the mixture, at what relative percentages, and numerous environmental factors (air speed across the surface, temperature, etc).

- The Occupational Safety and Health Administration (OSHA), National Institute for Occupational Safety and Health (NIOSH), and the American Conference of Governmental Industrial Hygienists (ACGIH) considered dermal routes of exposure in the development of the Benzene standard. After addressing dermal exposures in the development of occupational exposure limits for benzene, OSHA set an airborne exposure limit. Rather than add the results of dermal exposure models to measured airborne exposures (acquired through validated, standardized methods), OSHA relied upon airborne concentrations derived from epidemiological studies in order to evaluate workplace exposures to benzene and benzene-containing solvents.
- There is no dermal exposure limit for benzene. A separate dose calculation was not added to the inhalation dose when developing the occupational health standards, i.e., OSHA Permissible Exposure Limit (PEL), ACGIH Threshold Limit Values (TLV®) and the NIOSH Recommended Exposure Limits (REL).

In light of these uncertainties and issues, OSHA, ACGIH, and NIOSH neither require nor recommend quantifying dermal exposures.

***Dermal Flux Models have not been validated for solvent mixtures and are therefore unreliable***

Uncertainties in dermal exposure models include the selection of input values for flux (the rate of movement of a substance through the skin), and other individual specific values such as surface area exposed, exposure duration and exposure frequency. For example, flux is impacted by the percentage of benzene in the mixture (reformate and crude oil contain a mixture of multiple chemicals); and the presence and type of co-solvents (e.g. aromatics, alcohols, aliphatics or water).

One of the major sources of variability in a dermal exposure model is the percentage of a chemical in a mixture and the other characteristics of the other chemicals in the mixture. The flux values for pure (neat) benzene from four studies varied from 0.1 to 1.85 mg/cm<sup>2</sup>-hour (an 18 fold variation). This shows the variability in experimentally derived flux values for pure benzene. For benzene in solvent mixtures such as gasoline, the measured flux values ranged from 0.00271 to 0.0626 mg/cm<sup>2</sup>-hour for gasoline containing 0.39% to 5% benzene, a 23-fold difference. Additional studies demonstrate the significant variability in

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determining the flux value for benzene in hydrocarbon mixtures.<sup>12,13,14,15,16</sup> See Table I. (Attachment III).

Many of the dermal exposure studies have “employed compounds applied to the skin in aqueous or single solvent systems, a dosing scenario that does not mimic occupational, environmental or pharmaceutical exposure where compounds are often exposed with associated solvents, contaminants or specific formulation additives. It is well known that such factors modulate absorption of compounds”.<sup>17</sup>

Fiserova-Bergerova (1993) explained that when inhalation is not the primary route of exposure for solvents, the lungs will aid in the excretion of the absorbed solvent. This represents another factor that has not yet been addressed in dermal flux models and is among the reasons why biological monitoring is more representative of total absorbed dose estimates of the amount absorbed into the body.

“Dermal absorption is affected by other routes of entry of the chemical into the body. The role of the lungs in the exposure to volatile chemicals deserves special attention. Dermal absorption increases the concentration in venous blood. Consequently, pulmonary uptake is reduced or is replaced by elimination.”  
“Extensive pulmonary clearance of volatile chemicals reduces their potential for dermal toxicity.”

If the concentration of the mixed venous blood is greater than the concentration of the arterial blood, then pulmonary wash out occurs. The pulmonary wash-out was documented experimentally for methanol and xylene.<sup>18</sup>

Dermal modeling applied for purposes of calculating exposure dose is not a standardized or accepted industrial hygiene method for evaluating an individual's exposures to volatile mixtures such as reformate or benzene for comparison with established occupational health standards. The degree of uncertainty associated with these models varies widely depending

12 Adami, et al. “Penetration of benzene, toluene and xylenes contained in gasolines through human abdominal skin in vitro.” *Toxicology in Vitro* 20-8 (2006): 1321-1230.

13 Blank and McAuliffe, 1985.

14 Franz, T.J. Chapter 5 “Percutaneous Absorption of Benzene.” In *Advances in Modern Environmental Toxicology. Volume VI – Applied Toxicology of Petroleum Hydrocarbons*. Editors: MacFarland, Holdsworth, MacGregor, Call, and Lane. Princeton Scientific Publications, Inc. 1984: 61-70.

15 Hanke et al. 1961.

16 Loden, 1986.

17 Riviere, JE and Brooks, JD. “Prediction of dermal absorption from complex chemical mixtures: incorporation of vehicle effects and interactions into a QSPR framework.” *SAR and QSAR in Environmental Research*, 18 (2007):1, 31 — 44.

18 Fiserova-Bergerova V. “Relevance of occupational skin exposure.” *Annals of Occupational Hygiene* 37 (1993): 673-685. p. 677



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on the input values used to estimate the flux, the use of a dynamic flux value for the specific material being evaluated and other exposure factor estimates.<sup>19</sup>

***Specific Reasons for this Lack of Reliability are:***

- (1) The process for modeling dermal exposures has not been validated and there is no reproducible measure of its precision or accuracy. Dermal dose model calculations have no known error rate for pure benzene or benzene-containing solvent mixtures;
- (2) Flux estimates for benzene have no known error rate, no known reliability, and no known reproducibility;
- (3) Dermal flux models are particularly unreliable when evaluating solvent mixtures because the skin barriers do not behave in the same way to a neat (100%) benzene product, as they do to benzene-containing solvent mixtures; and
- (4) Methods, in development to quantify exposures via the dermal route of exposure, rely on direct measurement of the chemical of concern or other internal markers of exposure measured in blood or urine utilizing validated methods.

The rate of absorption can be dramatically impacted by the volatility of the various components of the mixture. Franz stated, "further work is needed ...to define the role of vehicle (solvents or mixtures other than pure benzene) in controlling percutaneous absorption of benzene."<sup>20</sup> Bowman and Maibach (2000) commented, "Industrial exposure is also often to mixtures and seldom to the neat compound or solvent. If one or several compounds are volatile, evaporative loss of one or several of these can dramatically change the absorption of the others as their relative concentrations are increased. Many organic solvents have a high vapor pressure and can be expected to have a substantial loss through evaporation when non- occluded skin is exposed."<sup>21</sup> For all the reasons noted in this section, benzene occupational health standards and guidelines are not based on dermal dose calculations.

***Plaintiff's Expert Mark Nicas Report***

According to Dr. Mark Nicas's discussion with the plaintiff, the plaintiff, for a period of one to one and one half years was involved in the removing of paraffin build-up in the well heads. Mr. Brown operated a self-propelled, self-elevating barge that operated

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<sup>19</sup> OSHA Preamble to the Benzene Standard. Federal Register 52(176): September 11, 1987; pp. 34487-34505.

<sup>20</sup> Franz, p. 70.

<sup>21</sup> Bowman and Maibach 2000; pages 131, 133.



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cutting tools that ran down into the well pipe. He told Dr. Nicas that "The barge crane lifted a tubular lubricator, the bottom of which was attached to the well head. A winch on the barge deck let out and reeled back a wire line equipped with cutting tools at its end. The wire line was lowered down through the lubricator and into the well piping. The cutting tool had a set of knives that removed the paraffin adhering to the interior pipe walls. Paraffin cutting often employed a solvent that was pumped from a 55-gallon barrel on the barge deck into the well piping." The solvent was pumped up to the top of the lubricator, and down through the lubricator into the well pipe.

Dr. Nicas attempted to quantify Mr. Brown's 8-hour Time-weighted average (TWA) daily exposure to benzene from the use of Shell Oil Company Reformat during this paraffin cutting at well heads located on satellite well platforms in Block 24. His approach to quantifying Mr. Brown's historical exposure to benzene from Shell Oil Company Reformat was based on two routes of exposure: inhalation and dermal routes.

#### ***Inhalation Dose***

For the inhalation exposure, Dr. Nicas utilized three long-term air monitoring data values taken on laboratory workers conducting "routine duties in reformat lab" to estimate the airborne concentration that Mr. Brown was exposed to while performing the paraffin removal. As previously noted a SEG is "A group of workers having the same general exposure profile for an agent because of the similarity and frequency of the task(s) they perform, the similarity of the materials and processes with which they work, and the similarity of the way they perform the task(s)."

In lieu of having personal monitoring data on Mr. Brown, personal monitoring data on another worker meeting the SEG criteria could have been used by the plaintiff's industrial hygiene expert to estimate Mr. Brown's exposure concentration. However in this case, the tasks performed and processes associated with Mr. Brown were in no way similar to the tasks and processes from which the plaintiff's expert derived the air monitoring data. The air monitoring data obtained from the laboratory workers was not relevant to Mr. Brown's airborne exposure while performing his duties on the well head. Importantly the environmental conditions, such as wind direction and speed (several hundred feet per minute), of Mr. Brown's outdoor workplace were not considered in evaluating the plaintiff's inhalation exposure. Instead the plaintiff's expert relied on air monitoring data taken from a laboratory worker working inside a laboratory with unknown ventilation rates. Therefore, the average benzene concentration estimated by Dr. Nicas is not a reliable estimate of Mr. Brown's exposure while using Shell's Reformat.

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### ***Dermal Dose***

For the dermal dose Dr. Nicas utilized a dermal flux model. This model calculated the amount of benzene absorbed based upon a flux value (the amount of material that absorbs through the skin per the amount of surface area exposed) and the duration of exposure.

Even if dermal flux exposure estimation models had been validated, Dr. Nicas's extrapolation of a flux value from pure benzene to predict a flux value for reformat containing various hydrocarbon chemicals including benzene has not been determined or validated, has no known error rate and is therefore unreliable. This approach does not address the differences in exposures based on personal factors (individual differences) nor does it address factors associated with the exposure environment (environmental factors such as temperature, airflow across the skin surface, etc.). Most significantly, his equation does not reflect the differences in flux based on the solvent (product) vehicle (formulation) or combination of other chemicals in the mixture.

Dr. Nicas did not consider the evaporation of benzene from reformat over time and assumes a constant concentration of benzene in reformat. However, he assumed that there was an airborne exposure to the benzene evaporating from reformat during this activity. Therefore, the estimated absorbed dose that Dr. Nicas converted to an airborne equivalent 8-hour TWA concentration and then added to his inhalation concentration estimate was not a reliable estimate of Mr. Brown's dermal or total benzene exposure. Finally, there is no standard or accepted method utilized by OSHA, NIOSH or the ACGIH for adding dermal dose to the measured airborne concentration for comparison with occupational health standards and guidelines.

Another task described by the plaintiff was the cleaning up of oil spills. Dr. Nicas attempted to quantify Mr. Brown's short-term airborne exposure to benzene during oil spill cleanups. He stated that Mr. Brown cleaned up oil spills and "platform carryovers" both as a laborer/maintenance man and as a lease operator. According to Dr. Nicas's report, spills could involve anywhere from a fraction of a barrel to several barrels of oil. However, this statement is not supported by the deposition testimony of Mr. Brown. Dr. Nicas cited several Shell documents that presented the benzene content in crude oils from various locations. The benzene content ranged from 0.058% to 0.569%.

To determine the airborne concentration of benzene, Dr. Nicas selected values between the high and low points of the range of values for the amount of oil spilled and concentration of benzene in the crude oil and suggested that a 50-gallon oil spill would cover a surface area of

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approximately 32 feet by 32 feet. He then assumed that 1% of the benzene in the crude oil would have evaporated rapidly in an air zone bounded by the surface area of the oil spill up to an elevation of five feet above the oil spill, essentially evaporating 1% of the benzene into a box the size of 32' x 32' x 5'. Based on this information, Dr. Nicas judged that during some spills Mr. Brown was exposed to benzene vapor concentrations exceeding 5 parts per million (ppm) over a 15-minute period of time. In this calculation the benzene in air concentration was 10.8 ppm benzene. He also stated that dilution air along with the removal of the oil would reduce this concentration to below 5 ppm as cleanup continued.

This calculation is flawed for several reasons. First of all, Dr. Nicas did not know the evaporation rate of benzene from crude oil. He provided no basis for the selected a value of 1% of the benzene in the oil being evaporated in an undesignated short time period. Secondly, he used a closed box model to represent the air space that Mr. Brown would have been exposed to during an oil spill cleanup. This closed box model did not consider the air flow on platforms out over open water and is not representative of the air space or environment that would have been around Mr. Brown during oil spill cleanups.<sup>22</sup> Therefore, Dr. Nicas's estimation of the short-term exposure concentration of benzene that Mr. Brown was exposed to during oil spill cleanups is neither relevant nor reliable.

However, if one were to take Dr. Nicas's approach of a box model and add ventilation (air flow) representative of the air speeds found in the area of South Pass<sup>21</sup>, and assume the benzene evaporated at a rate of 4,996 mg/min (1% of benzene mass per minute from Dr. Nicas's report) the resulting air concentration would not exceed 0.3 ppm benzene in air and this level would decrease rapidly over time due to the removal of the spilled oil (see Attachment IV). The maximum concentration of 0.3 ppm would not have exceeded the consensus and regulatory standards of the time period during which Mr. Brown worked for Shell or current regulatory and consensus standards for benzene (see Attachment V).

#### ***Plaintiff's Expert Melvyn Kopstein's Report***

Upon initial review of Dr. Melvyn Kopstein's report, it was evident that he cited documents and corresponding industrial hygiene data that had no relevance to Mr. Brown's work tasks or exposures. For example, Dr. Kopstein stated in his report that he relied on "two studies published in the peer-reviewed literature that present published benzene air monitoring data that are well in excess of threshold limit values (TLVs) for benzene at all times that Mr. Brown worked for Shell Oil and Shell Offshore." The Williams, et al (2005) paper pertained to benzene exposures associated with tasks performed on Marine Vessels. Dr. Kopstein stated that this publication indicated short-term exposures were well in excess of 50 ppm for tasks associated with petrochemicals (e.g. gasoline). This task involved checking gasoline

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<sup>22</sup> National Data Buoy Center, [http://www.ndbc.noaa.gov/station\\_page.php?station=burl1](http://www.ndbc.noaa.gov/station_page.php?station=burl1)

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tank levels on Swedish tankers with benzene content of 4% to 5 %. None of the tasks in the cited paper had any relationship to Mr. Brown's work tasks.

The other study cited by the plaintiff's expert was written by Caldwell et al. (2000), which is a compilation and analysis of the literature involving hydrocarbon solvent exposure data spanning over four decades. The data cited in this report is representative of personal air monitoring conducted on rubber spreading, gravure press operation, ink mixing, tanning, solvent cleaning, silk screening, adhesive application, fiberglass molding, stain removal, paint mixing, rubber mixing, etc. These processes, were not representative of Mr. Brown's job tasks while employed by Shell Oil or Shell Offshore as described in Dr. Nicas's report. Dr. Kopstein stated the 719 benzene samples taken had an average of 13.75 parts per million (ppm). However, this was not an accurate statement. The average of all these non-representative data points was actually 2.6 ppm which was representative of a great variety of solvents, with varying benzene content, and in varying workplace environments.

Dr. Kopstein stated he intended to employ the same methodology "as appropriate" that Shell used in their retrospective benzene exposure study at two refineries in 1984. Specifically, he will use odor as a means to quantify a range of exposure levels to an airborne petrochemical contaminant. He cited Ruth (1986) in stating "Odor thresholds are used routinely as a tool in recognizing and responding to potential hazards." Recognition of an odor is vastly dissimilar from quantifying a vapor concentration. In this same article Ruth stated in the opening sentence of the paper, "the sense of smell cannot be relied upon to evaluate the hazards of chemicals used in the workplace." There are no statistically valid methods for quantifying benzene exposure by odor determination. Odor detection is neither a standard nor accepted industrial hygiene practice for benzene exposure assessment.

Dr. Kopstein's intended use of odor as a means of evaluating benzene concentrations is neither relevant nor reliable. The use of odors as a means of quantifying ambient benzene concentrations is not relied upon as a means of evaluating occupational exposures. It is an accepted tenet of exposure assessment methodology that qualitative perceptions are of limited value and are far less accurate than quantitative data. According to Amoores and Hautala (1983), the nose is "...at best only semi quantitative, and it required calibration to determine its sensitivity..." The reason for this is that olfactory thresholds are extremely variable among subjects (Stevens, et al. 1988). Precise threshold values do not exist and an odor panelist's ability to detect an odor stimulus varies as a result of random variation in factors including alertness, attention, fatigue, events at the molecular level, and health status (ASTM 2004).

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## Conclusions

Based on the documents and literature I have reviewed I express the following opinions to a reasonable degree of scientific certainty. It is clear that neither Dr. Nicas nor Dr. Kopstein followed appropriate exposure methodologies. Their failure to adhere to these methodologies and their use of inappropriate data renders their opinions regarding Mr. Brown's alleged benzene exposure neither relevant nor reliable. Specific opinions regarding Drs. Nicas and Kopstein's report are as follows:

### Dr. Nicas

- The industrial hygiene data used by Dr. Nicas to estimate Mr. Brown's airborne exposure to benzene from the Paraffin Cutting operation is not relevant to Mr. Brown's alleged exposure to benzene from the reformat. Therefore, his estimate of Mr. Brown's inhalation exposure to benzene is neither relevant nor reliable.
- Dr. Nicas's methodology for determining dermal dose has not been scientifically validated, is not reliable, nor is it a standard and acceptable industrial hygiene practice for quantifying dermal dose. The dermal routes of exposure have already been accounted for in the OSHA regulations and other standard setting agencies during the development of the standards. OSHA, ACGIH, and NIOSH neither require nor recommend quantifying dermal exposures and there is no means of comparing dermal exposure to occupational health standards or guidelines.
- Dr. Nicas's methodology for estimating Mr. Brown's short-term airborne exposure concentration to benzene from oil spill cleanup operations is not representative of Mr. Brown's exposure. His closed box model did not account for the substantial vapor dilution as the result of Mr. Brown's open air work environment. Furthermore, he provided no basis for his assumption as to the benzene evaporation rate and therefore was immediately available for inhalation. Both the lack of ventilation and the immediate evaporation of benzene assumption presented by Dr. Nicas render his opinion to be scientifically inaccurate.

### Dr. Kopstein

- The references cited by Dr. Kopstein have no bearing on Mr. Brown's work tasks and therefore the cited data would not be representative of Mr. Brown's alleged benzene exposure. Therefore, his estimate of Mr. Brown's inhalation exposure to benzene is neither relevant nor reliable.
- The reliance on an odor threshold as a means of quantifying ambient concentrations is not an accepted industrial hygiene practice or an appropriate means to assess exposures. There is significant inter- and intra- variability in an individual's ability

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to detect odors. Odor thresholds that are available vary widely and, as such cannot be used to predict air concentration with any degree of scientific certainty. Therefore, Dr. Kopstein's reliance on odors cannot be considered relevant or reliable in assessing Mr. Brown's exposures.

My opinions are based on my more than 32 years of experience as an industrial hygienist and safety professional. My experience has included health hazard evaluations and audits of multiple operations within facilities similar to and the same as those workplaces experienced by Mr. Brown. My experience has also included the development of exposure assessment strategies, and training of employees who worked in numerous industrial operations. I also base my opinion upon portions of the scientific literature focused on occupational health hazard assessment.

To date, the following materials have been reviewed and/or relied on specifically for this case.

1. Plaintiff's Initial Disclosure
2. Plaintiff's Supplemental Initial Disclosure
3. Plaintiff's First Amended Complaint for Damages
4. Plaintiff's Employment Records
5. Plaintiff's Claim for Compensation
6. Report of Melvyn Kopstein, Ph.D., w/ CV, Testimony List and Publications
7. Report of Mark Nicas, 5 Jan 2009 w/ CV & References
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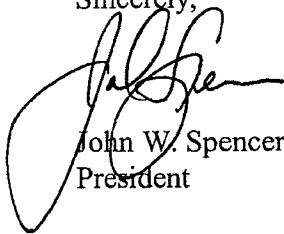
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My summary report is based on the information available to me at this time. Upon receipt of additional information, I reserve the right to determine the impact, if any, of the new information on my opinions and conclusions, and to revise my opinions and conclusions as necessary.

Sincerely,



John W. Spencer, CIH, CSP  
President

JWS/ddj

- Attachment I: Curriculum vitae of John W. Spencer, CIH, CSP  
Attachment II: John Spencer Four-Year History of Testimony  
Attachment III: Table 1: Benzene Dermal Flux Data for Various Liquid Mixtures Containing Variable Benzene Levels  
Attachment IV: Oil Spill Calculations Using Dr. Nicas's Box Model  
Attachment V: Historical Occupational Exposure Limits for Benzene